the *Travailleur* and *Talisman.* These include several Brisingidæ and Stichasteridæ; species of Cribrella and Solaster; several Pterasteridæ, a family almost entirely confined to great depths; many Goniasteridæ, and some Archasteridæ and Porcellanasteridæ. Asteriadæ and Asterinidæ are almost wanting, Linckiadæ entirely so. Sixty-four species is the total, of which fifty are new.

Mollusks.—The Archiv. für Naturgeschichte for 1885 (part III) contains remarks upon the post-embryonal development of the Naiadæ, by Fred. Schmidt.——In a second article upon the molluscan fauna of Behring's sea (Arch. f. Naturgeschichte, 1885, part III) A. Krause enumerates sixty-six Gastropoda, including several new species and three Pteropods, one of which is new.

Mammals.—Dr. E. L. Trouessart (Ann. d. Sci. Naturelles) supports his previously-expressed views that the musk-rat of the Antilles should be placed in the genus Hesperomys, but made the type of the sub-genus Megalomys. The form of its teeth will not permit it to be ranged under the sub-genus Holochilus, which is by Mr. Thomas considered to be a genus. *Megalomys pilorides* has as yet been found only in Martinique and St. Lucia. It reaches the size of a rabbit, and did great damage to the plantations. Systematic war waged upon it by the colonists has almost, if not quite, brought about its extinction, so that the examples in the Paris Museum are perhaps all that is left of this curious and interesting species. [The name Megalomys is preoccupied.–*Ed.*]

EMBRYOLOGY.[1]

1. THE DEVELOPMENT OF PATELLA.—Dr. William Patten,[2] of Boston, while working in Claus's laboratory at Trieste, succeeded in artificially fertilizing the ova of a species of Patella, the specific name of which is not given. The ova measured 0.12^{mm} in diameter; bluish-green in color and opaque. Acetic acid and glycerine were used to render them transparent enough for a study of the general external characters. The internal changes were studied by means of sections. The eggs were matured from the first of November to the middle of January.

The ova were covered by a very thick transparent chorion, traversed by fine pore canals. The micropyle was a wide crater-like opening in the chorion at one pole of the egg; within this opening were a number of highly refractive globules which greatly interfered with the observation of the fecundation and formation of the polar globules. Ten minutes after removing the ova from the ovaries, the pole globules appear as two colorless and transparent prolongations arising from the surface of the ovum at the bottom of the crater-like micropyle. The polar cells are of great

[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

[2] The Embryology of Patella. Arbeiten aus dem Zool. Inst. zu Wien. Tom. VI, Hft. 2, pp. 149–174, pls. I to V, 1885.

size as compared with those of other types. Two polar globules arise side by side and not one beneath the other, as in other cases. As many as five distinct polar globules were extruded in abnormal cases, and the extremity of one of these was enlarged into a globular form, the same as one of the two in the case of the normally developing egg. The polar cells finally become much reduced in size and are easily detached from the egg.

The segmentation is slightly meroblastic and a hollow blastula is soon formed; hatching occurs in about ten hours, when the apical cells and the two equatorial rings of velar cells have become ciliated. At the vegetative pole of the blastula four large, so-called *endo-mesodermal* cells, forming part of the wall of the blastula, are elongated and prolonged into the blastocœl and two of them have their inner ends segmented off to form the primitive mesoderm; the other two and what remains of the two preceding ones give rise to the endoderm or intestine, while the decreasing area on the outside of the blastula embraced by the endo-mesodermal cells represents the blastopore. The primitive pair of mesoblastic cells are bilateral in position and render the larva bilaterally symmetrical. The blastoporic area gradually assumed a more ventral position and is then shoved forwards and inwards, finally disappearing at the bottom of a deep furrow which partially closes or concresces from behind forward, leaving the permanent mouth—stomodæum—at its anterior end, from which the œsophagus extends inwards toward the original site of the blastopore at the bottom of the stomodæal invagination. On either side of the posterior part of the stomodæal furrow there is a swelling; this pair of swellings eventually leads to the formation of the foot, on either side of which the otocysts are invaginated. At this stage also the shell gland is developed and the two primitive mesoblastic cells have segmented into a row of three cells each, lying symmetrically on either side of the median plane of the embryo. A glossophoral sac is formed in the floor of the œsophagus, and the anus is obviously broken through late.

The important points brought out in this paper are the following: (1) the possibility of artificially fertilizing the eggs of Gastropods; (2) the presence of a definite blastoporic area which is carried ventralwards and forwards leading to the formation of the mouth and œsophagus; (3) the presence of a pair of bilaterally disposed primitive mesoblast cells, derived from two of the endo-mesodermal cells, and the subsequent development from the former of a pair of mesoblastic cords on either side of the median line; (4) the partial concrescence and closure from behind forwards of the ventral furrow in which the blastopore is situated.

The oldest embryo figured is one of 130 hours. The figures are excellent, and the paper as whole bears evidence of having been prepared with great care, and represents an important contribution to molluscan embryology.

2. THE DEVELOPMENT OF DENTALIUM.[1]—M. Kowalevsky concludes that the development of Dentalium has a good deal in common with that of the Lamellibranchs, the segmentation resembling that of Unio as described by Rabl, and Teredo as described by Hatschek. The segmentation is nearly regular, and leads to the formation of a hollow blastula and an invaginate gastrula. The mesoderm is derived from the inner wall of the invaginated side of the blastula, and the mesodermic cells are disposed symmetrically on either side of the median line. The shell-gland becomes defined very early on the dorsal aspect of the embryo, and as the blastopore travels forward, as in Patella, the area of the shell-gland, or mantle-organ, becomes greater, so that it gradually embraces the body of the embryo, especially over the region just behind the foot, leading to the development of the characteristic tubular shell. The resemblance of the larvæ of Dentalium to those of the Annelids is shown to be only a very superficial one. Three ciliary girdles encircle the anterior or cephalic pole of the larval body. The blastopore is wide at first, and persists as such much longer than in Patella; it is also elongated in the process of shifting towards the ventral, anterior aspect. A radular sac is developed on the inferior side of the œsophagus. The cephalic ganglia develop from a pair of deep invaginations of the ectoderm of the velum; the pedal ganglia from a pair of proliferations of cells from the ectoderm of the foot. The otocysts are developed before the pedal ganglia on either side of the foot and much in the same way as in Patella.

This memoir, illustrated with eight well-executed plates, the figures being drawn from actual sections, is a very important contribution to molluscan morphology, as nothing of equal value has appeared since the publication of the paper on Dentalium by H. Lacaze-Duthiers in 1857.

3. THE DEVELOPMENT OF THE CHITONIDÆ OR POLYPLACOPHORA.[2]—This important paper by M. Kowalevsky discusses very fully the development of *Chiton polii*, valuable observations being also recorded upon *Ch. olivaceus* Spengler, and *Acanthochites discrepans* Brown. The ♀ carries about a mass of eggs in the mantle cavity, between the gills and mantle; those set free by the ♀ do not develop normally. The ova are enclosed by a chitinous covering, consisting of hexagonal plates which support processes externally, which vary in form in the various species.

The four first segmentation spheres are nearly equal; each of these subdivide into two, giving rise to four upper and four lower ones. The polar globules rest near the center of the area

[1]Etude sur l'Embryogenie du Dentale, memoire VII, par M. A. Kowalevsky, Ann. du Mus. d'Hist. Nat. de Marseille, Zool. Tom. I, Seconde partie, 1882–1883.

[2]Embryogenie du *Chiton polii* (Philippi) avec quelques remarques sur le Developpement des autres Chitons, memoire V, par M. A. Kowalevsky, Ann. Mus. d'Hist. Nat. de Marseille, Zool., Tom. I, second partie, 1883. 4to, pp. 46, pls. VIII.

embraced by the four upper, smaller cells of the animal pole. By division of the lower cells there arises a third layer of four intermediate cells, and soon after these four others appear which are apparently derived from the four upper ones. Thereupon six more smaller cells are developed at the animal pole, and somewhat later eight more such appear at the vegetative pole, so that the embryo is now composed of thirty-six cells. At this stage the gastrula mouth begins to develop; at first, as a slight depression, which later becomes deeper, leading to the formation of a symmetrical gastrula consisting of ecto- and endoderm. The two annuli or cycles of large cells, which represent the velum, are now differentiated.

The gastrula is next somewhat elongated, and near the blastopore an endodermal cell is pushed into the blastocœl to give rise to the mesoderm. The blastopore is soon displaced somewhat ventralwards, and simultaneously certain ectodermal cells are drawn inwards to form part of the wall of the cavity of the gastrula. There are two distinct, symmetrically disposed groups of mesodermal cells near the blastopore; the largest of these cells still form part of the endoderm and take part in limiting the cavity of the gastrula. The blastopore is gradually shoved nearer to the velum, and in connection with it is developed an œsophagus formed of ectodermal cells. The mesodermal cells have multiplied, but retained their bilaterally symmetrical position.

The œsophagus is now a spacious sac, from the posterior, inferior wall of which a radular sac has been invaginated. Immediately behind the mouth, in a median line, there is developed an invagination, which Kowalevsky calls the pedal gland. Two longitudinal, anteriorly conjoined thickenings of the ectoderm, which encroach upon the mesoderm, form the rudiments of the pedal and branchial nerves. The four nerve cords are gradually split off from the ectoderm and assume their definitive position in the mesoderm. The cavity in the pedal gland becomes filled with a slimy secretion. At the apex of the velar area a pair of ectodermal cells support a tuft of cilia. At certain points, where spiculæ appear later, each spicule-forming ectodermal cell acquires a clear vacuole. There now appear seven transverse furrows on the dorsal aspect, in each of which the cuticula, which now covers the back, becomes thickened. The ventral aspect is now mostly embraced by the foot, which consists of a layer of deep columnar ciliated cells. Anteriorly the cephalic ganglion is developed as a cellular body, enclosing a hollow cavity, and posteriorly the branchial ganglion appears as the widened ends of the two branchial nerves, lying close to the ectoderm. The posterior section of the gut is surrounded by a dense mass of mesodermal cells, which doubtless furnish the materials for the development of the segmental organs, vessels and sexual organs. At a somewhat later stage fibrils from multipolar cells are developed in the

cephalic ganglion. In the anterior part of the body, the mesodermal cells form a gelatinous connective tissue between the organs. The pedal gland is now very strongly developed; its secretion is poured out between the ectodermal cells, a special opening for it being absent. At the sides of the body, above the foot, a ciliated band is present, which marks the site where the branchiæ will appear. At the level of the first dorsal fold, the eyes may be recognized. The larva now leaves the egg envelope and swims about by means of its velum. The calcareous spicules are still enclosed by their mother cells, but soon break through. After the lapse of several hours to several days, the larvæ finally rest on the bottom, losing the velum, which is replaced by other ectodermal cells. A diverticulum of the intestine at this time probably represents the liver. An invagination at the posterior end of the body seems to be the rudiment of the rectum. The pedal gland seems to have become smaller than in the preceding stage; in young Chitons (probably a year old) it is still present, but in those somewhat larger it is absent; it is, therefore, an organ pertaining to the embryonic period. The cuticular thickenings which lie in the transverse dorsal furrows are the rudiments of the segmented shell, and in each furrow, beginning at its anterior border, small calcareous plates are formed. The eyes are heaps of pigment in the ectoderm, with a clear nucleus in the center, lying close to the branchial nerves. In a fully developed young Chiton they were sunken into the skin and the ectoderm became circumscribed somewhat in the form of a cornea. The eight segments of the shell appear sometime after the metamorphosis in *Ch. polii* and *cinereus*, but in *olivaceus* somewhat before it.

4. THE DEVELOPMENT OF THE GILL IN FASCIOLARIA.[1]—Dr. Osborn's observations show that the gill of this gastropod is developed from a ridge of the ectoderm formed in the median line between the border of the advancing mantle and the velum. Later, with the growth and folding forward of the mantle and the formation of a mantle cavity, the gill is also carried forward and is brought to occupy a position on the outer instead of the inner wall of the branchial chamber. This change of position, the author finds, is entirely due to the manner in which the mantle cavity is developed. The species investigated by Dr. Osborn was *F. tulipa* Linn., var. *distans* Lam.

[1] H. Leslie Osborn. Studies from Biolog. Lab., Johns Hopkins University, III, No. 5, pp. 217–225, pl. XIII, 1885.